Transesterification of waste oil using a bifunctional catalyst

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Biodiesel is one of the most important sources of sustainable energy, is a form of biofuel used as a substitute for fossil diesel, and chemically consists of a mixture of methyl esters of fatty acids (FAMEs). Biodiesel is obtained, mainly from tranesterification of triglycerides (TG). Biodiesel has several chemical advantages over fossil diesel, including higher combustion efficiency, flash point, and cetane number. It is biodegradable, renewable and reduces the emission of polluting particles. Despite the advantages, the industrial production of biodiesel is limited due to high production costs with the current technology, specifically when used basic homogeneous catalysts. Several researches have proposed the use of waste oils as raw material with the aim of reducing production costs, minimizing the costs of operations and making the process friendly to the environment. To achieve the above, the synthesis of new catalysts is of vital importance. Bifunctional heterogeneous catalysts contain both acid and basic sites; therefore can simultaneously carry out esterification of free fatty acids and transesterification of triglycerides. These catalysts are promising in the production of biodiesel from used cooking oil and they could to reduce production costs. In this work, the catalytic activity of iron oxide (III) doped with calcium oxide (Fe2O3/CaO) as a bifunctional heterogeneous catalyst for the biodiesel production using waste oil as raw material was investigated. The optimal conditions for the synthesis of catalysts (temperature of activation, percentage of impregnated iron (III), and iron (III) precursor specie) were determined. Additionally, the conditions of reaction process (molar ratio alcohol-oil, temperature of reaction, catalyst loading and reaction time) were optimized. The Fe2O3/CaO was characterized by SEM-EDS, XPS and TGA. The final Biodiesel samples were analyzed by gas chromatography follow the European Regulation (UNE-EN14103) and ICP analysis was made to determinate the leaching of calcium and iron. In summary, a bifunctional catalyst was successfully synthesized to transform the waste oil into high quality biodiesel without soap formation.

Biography: Vania Nayeli Enguilo Gonzaga is Chemical Engineering from the Universidad Autónoma del Estado de México (UAEM). Currently, she is pursuing a Master's Degree in Chemical Sciences at the UAEM. Her current research is focused on the heterogeneous catalysis and transesterification of vegetable oils to obtain biodiesel. She worked at DuPont Crop Protection like engineer of quality assurance, and during this time, she obtained an ISO certification as quality auditor, also she collaborated with the implementation and validation of analytical methods. Currently, she is making a research stay at Castilla-La Mancha University, Spain. The purpose of her research stay is characterizing the bifunctional catalysts synthesized and the study about doping of nanomaterial with nitrogen heteroatoms.

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